Remote sensing of hurricane impact (DEAN, 2007) and early vegetation recovery in the mangrove of Fort-de-France Bay (Martinique, French West Indies)

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Photo: *Reuters*

CONTEXT

- **CARIBSAT Project** aims at conceiving and implementing an instrument to monitor the environment in the Lesser Antilles based on an online geographic atlas supplied by the acquisition and analysis of satellite images, ground environmental data as well as hydro-meteorological reports. More specifically, it is targeted towards the preservation of biodiversity in terrestrial and marine ecosystems, the mitigation of risks associated to natural disasters and the adaptation to climate change.

- **Hurricane Dean (2007)** severely impacted **mangrove** forests along the Bay of Fort-de-France (Martinique, FWI). This event provided an opportunity to assess mangrove resistance and early recovery following hurricane disturbance, both of these processes being yet poorly understood in mangroves worldwide. For this purpose, three sequential maps of mangrove vegetation around the Bay have been implemented by means of satellite image analyses (IKONOS 2006 and 2008, SPOT 5 2006 and 2010) and field measurements.

METHOD

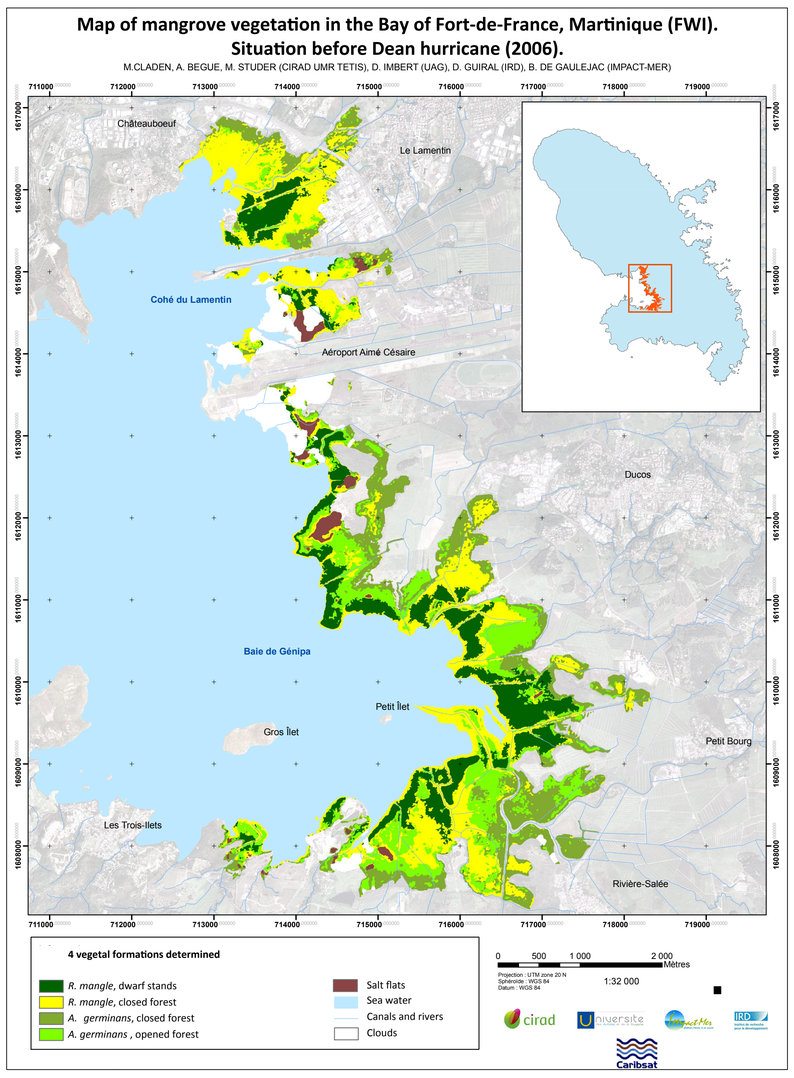
Data used for mapping:

• ANTE HURRICANE DEAN :
- Images **Ikonos** at 4x4 m and 1x1m (8.5.2006), **SPOT 5** at 10x10 m and 2,5x2,5 m (11.14.2006), **BD ortho® IGN** (2004)
- Map of wetland soils and vegetation around the bay of Fort-de-France (D. Imbert and M. Brossard, 1987)
- Field survey, (May 17-26 and October 27 to November 7, 2010) in collaboration with the Natural Park of Martinique.

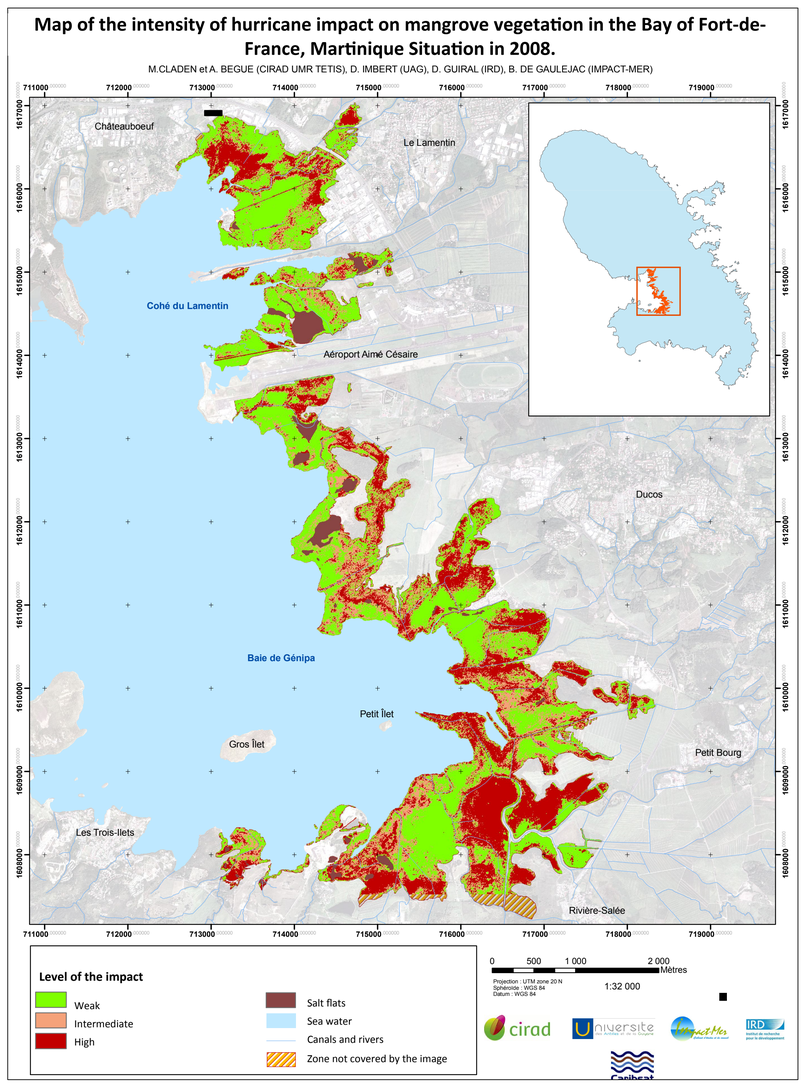
• HURRICANE DEAN IMPACT :
- Impact map realised from IKONOS satellite images (February 16, 2008) and aerial photographs taken from helicopter after the hurricane (DIREN).

• POST HURRICANE DEAN :
- The post-Dean map was realised with the Spot satellite image of March 26, 2010.

BEFORE HURRICANE

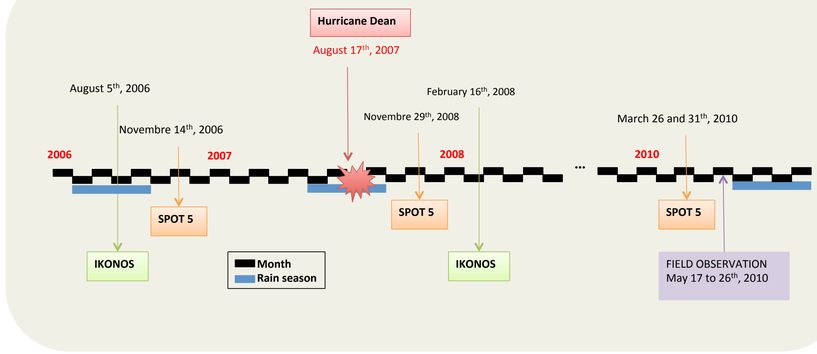


HURRICANE IMPACT

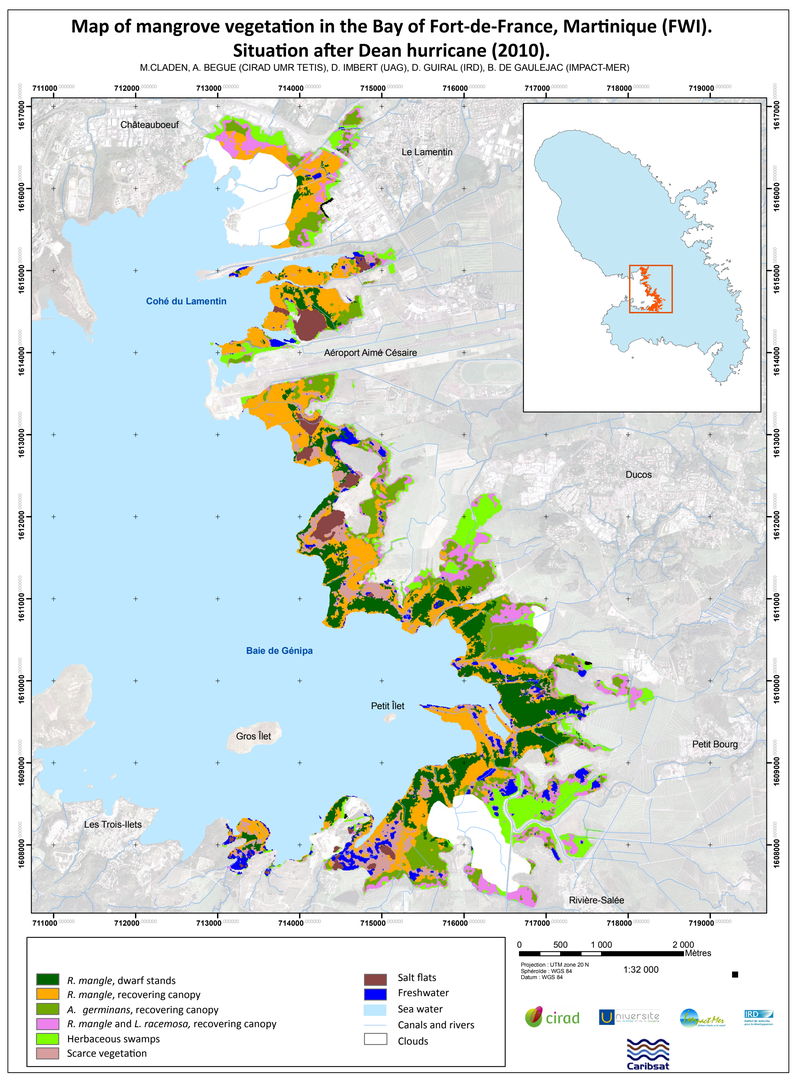


Classification	Impacted areas (ha)
Weak impact	585
Intermediate impact	262
High impact	326
TOTAL	1210

Table 1: Repartition of impacted areas



AFTER HURRICANE



MAIN RESULTS

- The first vegetation map allowed for the description **of 4 pre-hurricane ecological units** based on vegetation structure and dominant species.
- The second map outlined hurricane disturbance using **three levels of vegetation damage** (weak, intermediate and high). It was found that Hurricane Dean impacted 52% of the study area at a medium or strong level. *Avicennia germinans* stands were the most heavily damaged, whereas dwarf *Rhizophora mangle* stands were the most resistant. It appeared that, in addition to wind damage, a massive and long-lasting increase of the water table due to freshwater flow impediment caused massive mortality among *A. germinans* stands.
- On the map of early (3 years) vegetation recovery, corresponding areas (13 % of the whole mangrove area) appeared as **freshwater marsh** vegetation. These results will serve to implement a mangrove observatory in Martinique Island, based on remote-sensing survey and vegetation monitoring on reference areas.